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Prairie Cluster Long-Term
Ecological Monitoring Program

Program Report
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Annual Status Report:

1999 Black-tailed Prairie Dog Monitoring for Scotts Bluff National Monument

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1999 Black-tailed Prairie Dog Monitoring at Scotts Bluff National Monument

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1.0 INTRODUCTION

1.1 Background

Prairie dogs (*Cynomys* sp.) once inhabited about 10 to 20% of the short and mixed-grass prairies of the United States (Anderson et al. 1986), but less than 1% of this historic range remains occupied (U.S. Fish and Wildlife Service 2000). The proximate causes for this decline include habitat loss due to conversion to cropland, urbanization, habitat modification and fragmentation, disease, and poisoning (U.S. Fish and Wildlife Service 2000). Additionally, the introduction of sylvatic plague (*Yersinia pestis*) into North America is presumed to be capable of causing massive prairie dog dieoffs (Barnes 1993; Cully 1993). The past and present status of the black-tailed prairie dog (BTPD), *Cynomys lucdovicianus*, in lands managed by the National Park Service (NPS) is poorly known. There are twenty-nine NPS units within the historic range of the BTPD. Twelve units historically supported BTPDs, but only seven units currently have BTPD populations.

Continual herbivory by BTPDs modifies the morphology, structure, and nutritive value of individual plants (Cid et al. 1989; Brizuela et al. 1986; Detling and Painter 1983; Holland and Detling 1990; Jaramillo and Detling 1988). The duration of colonization modifies the microhabitat along a disturbance gradient resulting in altered rates of microbial activity, nutrient cycling in soils, and water balance in plants (Archer and Detling 1986; Holland and Detling 1990; Whicker and Detling 1988). These impacts create a habitat mosaic that has been suggested to be beneficial to other species (Agnew et al. 1986; Sharps and Uresk 1990) such that in mixed prairie, approximately 40% of vertebrate wildlife species have some association (i.e., from obligate to accidental) with prairie dog colonies (Sharps and Uresk 1990). However, the small size and isolation of "island" fragments increase their vulnerability to changes in landuse, disturbance regimes, and diseases.

BTPD monitoring at Scotts Bluff National Monument (SCBL) and six other prairie parks began in 1995 to collect baseline data while simultaneously developing a monitoring protocol for the NPS Prairie Cluster Long-term Ecological Monitoring program.

1.2 Objectives

The objective of BTPD monitoring is to determine: 1) BTPD density and total abundance; 2) size and location of BTPD colonies, achieved by producing annual colony maps; and 3) surveillance of sylvatic plague.

2.0 METHODS

2.1 BTPD density and total abundance

The BTPD monitoring methodology is detailed in Plumb et al. (2000). There is only a single BTPD colony (<16 ha) at SCBL, so the entire colony is included in the counting. Sampling should be carried out during June and/or July: 1) when vegetation is at or near peak

development but prior to senescence, 2) following emergence and prior to dispersal of young-of-the-year BTPD, and 3) when the BTPD-induced vegetation clip line colony "edge" is most easily discerned. Eight replicate counts, with 15-minute intervals between replicates, are made on each of three successive days, if possible. Counts should be completed between 1000 and 1100 hours each morning.

1. *BTPD predicted density* — Using the maximum count value among all counts, the predicted BTPD density, P, is calculated from the linear relationship described in Severson and Plumb (1998). In this linear model $P = ([Y/S_p] - 3.04)/0.40$, $r^2 = 64.6$, $P < 0.0001$, where

P = the estimated density of prairie dogs (individuals ha^{-1}) in the total area sampled,
S_p = the total area sampled, either the 4-ha sample plot, or total colony area if less than 4 ha; and
Y = the maximum visual count recorded over all plot counts

Using the data from Severson and Plumb (1998), the standard error (SE) of P can be calculated from the relationship:

$$\text{Variance } (P) = MSE/b^2 \left(1 + 1/n + [P - \bar{x}]^2/\sum [x_i - \bar{x}]^2\right) \text{ where}$$

MSE = mean square error = 10.1
b = 0.4
n = 24
$\bar{x} = 18.4$
$\sum [x_i - \bar{x}]^2 = 2512$

Variance (P) then becomes: Variance $(P) = 66 + 0.025 (P - 18.4)^2$, and SE (P) = $\sqrt{}$ Variance (P) (Neter et al. 1990).

2. *BTPD total colony population abundance* — Using the predicted density estimate, P, derived above, the total BTPD colony population abundance, T, is calculated as: $T = (S_c)(P)$, where S_c is the total colony area (ha) derived from the GPS survey. The SE of the abundance estimate is derived from:

S_c is the total colony area (ha) derived from the GPS survey.
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Variance $(T) = (S_c)^2$ (Variance [P]), and
SE (T) = $\sqrt{}$ Variance (T)
(Neter et al. 1982)

3. *Interpreting changes over time* — Because the two BTPD metrics of interest, density (P) and abundance (T), represent a single annual value derived from the calculations above, there are limited options for statistical comparisons. Unreplicated data could be tested using the Z-test,

but that test does not account for potential autocorrelation problems which could occur especially if surveys are conducted annually. The best alternative is to calculate confidence intervals for the metrics, and compare those between years (Johnson 1999). Estimates with broadly overlapping intervals are not likely to be significantly different, whereas those with non-overlapping intervals would be clearly significantly different. The 95% confidence intervals for density and abundance, or any normally-distributed variable (Sokal and Rohlf 1969) can be calculated as:

Lower limit, P = P - 1.96 [SE(P)]
Upper limit, P = P + 1.96 [SE(P)]

Lower limit, T = T - 1.96 [SE(T)]
Upper limit, T = T + 1.96 [SE(T)]

where P and T are the quantities derived as described in section 2.1. The critical value of 1.96 is obtained from statistical tables (Rohlf and Sokal 1981) and represents the area of the t-distribution containing 95% of the parameter estimates for α=0.05 with n-1 degrees of freedom. The value for the standard errors of P [SE(P)] and T [SE(T)] are those calculated in section 1 and 2 above, respectively.

2.2 BTPD colony mapping

Plumb et al. (2000) describe the use of a Global Positioning System for delineating irregular land surface polygon boundaries and sizes in conjunction with PC-based Geographic Exploration Systems such as ArcView™.

Before conducting GPS mapping, use colored pin flags to mark the edge of the colony. Select a starting point, mark this point with a flag, and begin walking the colony edge in either direction, following the vegetation clip line. When the continuity of a vegetation clip line disappears or cannot be reasonably determined, continue to encircle the colony with an imaginary line that incorporates the extent of the active burrows (e.g., > 7 cm burrow opening with fresh scat within 0.5 m, *sensu* Biggins et al. 1993) within five meters of actively grazed vegetation. There may be exploratory burrows at great distances from the main colony, but burrows > 5 meters from actively grazed ground should be excised. Otherwise, extensive areas of uncolonized grassland could be included. While walking the colony edge, place the pin flags approximately 10 meters apart or at shorter, reasonable intervals that will clearly delineate undulating changes in the perimeter of the colony polygon. Completely walk the entire colony edge, arriving back at the initial flag, thus closing the colony polygon. Determine the area of the colony polygon by walking the entire marked perimeter using the GPS unit according to the manufacturer's specifications.

2.3 Sylvatic plague surveillance

Sylvatic plague is not known to be active in BTPD population in any NPS unit. Small

parks such as SCBL, which has only one BTPD colony, are at highest risk of local extinction due to wildlife disease. In the absence of an ongoing epizootic, sylvatic plague surveillance takes the form of low-level local sampling paired with consistent liaison with state and local health departments and an informal surveillance network of biologically oriented public agencies and individuals (Barnes 1982). Upon evidence of activity or detection of plague locally, the appropriate state and local health agencies should carry out further surveillance.

Park staff should conduct an annual visual survey, denoting on a copy of the current colony map the estimated spatial extent of the active colony and a visual estimate of prairie dog numbers (0-10, 10-30, 30-120, 120-360, > 360). Surveys should be done between 0800 and 1000 (period of peak BTPD activity) with clear sky and low wind. Plotting abundance and distribution estimates across years will generate long-term trends from which dramatic order of magnitude deviation, indicative of substantial mortality and possible plague outbreak, can be detected. Upon evidence of a substantial decline in BTPD activity or detection of plague locally, the appropriate state and local health agencies should carry out further surveillance. Contacts to be alerted at this level of concern are listed in Appendix A.

3.0 RESULTS

3.1 BTPD density

The results of BTPD monitoring between 1995 and 1999 are given in Table 1. Population density estimates (± 95% confidence intervals) are shown in Figure 1, and total colony population size estimates (± 95% confidence intervals) are shown in Figure 2. Original data sheets were consulted for the count values used in 1996, 1998, and 1999. The original count data sheets for 1995 and 1997 were not available, and those maximum count values were derived from back calculations of reported densities (National Park Service 1997) using the Severson and Plumb (1998) regression.

Population density increased five-fold between 1995 and 1996, as the number of individuals increased while the colony size remained the same (Table 1). The lack of overlap between the confidence intervals for those two years indicates a significant increase. After 1996, population density declined as a result of expanding colony area, but the overlap in confidence intervals suggests the changes were not significant (Figure 1). Similarly, total colony population size increased significantly between 1995 and 1996 (no overlap of confidence intervals), increasing more than four-fold (Figure 2). Since 1996, the total colony population abundance remained stable until 1999, when it nearly tripled in size (Figure 2).

It is unknown to what extent important factors such as vegetation dynamics or weather may have caused the recent increases in the BTPD population. Long-term monitoring of these parameters in conjunction with continued monitoring of BTPDs will provide the best information for park managers to assess the magnitude of population changes and the causes of these fluctuations of BTPD numbers.

3.2 BTPD Colony Mapping

Maps showing the changes in the size, shape and location of the BTPD colony at Scotts Bluff from 1995 to 1999 are shown in Figures 3-6.

3.3 BTPD Plague Surveillance

To date, plague has not been known to have historically occurred at SCBL. Although active surveillance for plague, as described above, has not been carried out at SCBL, there has been no indication of possible plague noted during the abundance surveys.

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Table 1. Maximum black-tailed prairie dog count, estimated population density, total colony size derived through GPS mapping, and total colony population abundance of black-tailed prairie dogs at Scotts Bluff National Monument 1995-1998. Population density and total colony population abundance estimates are shown ± standard error.

Year	Maximum count	Population density (individuals ha^{-1})	95% Confidence interval	Colony size (ha)	Total colony population size (individuals $park^{-1}$)	95% Confidence Interval
1995	11	12.0 ± 8.2	-4.1 to 28.1	1.4	16.8 ± 11.5	-5.7 to 39.3
1996	34	53.1 9.8	33.9 to 72.3	1.4	74.3 13.7	47.4 to 101.2
1997	38	28.9 8.3	12.7 to 45.2	2.6	75.1 21.6	32.8 to 117.4
1998	40	22.7 8.2	6.6 to 38.8	3.3	74.9 26.9	22.2 to 127.6
1999	102	20.4 8.1	-4.5 to 36.3	9.1	185.6 73.7	-41.1 to 330.1

Figure 1. Estimates of black-tailed prairie dog densities (individuals ha^{-1}), $\pm$ 95% confidence intervals from 1995 through 1999 at Scotts Bluff National Monument.

SCOTTS BLUFF NATIONAL MONUMENT

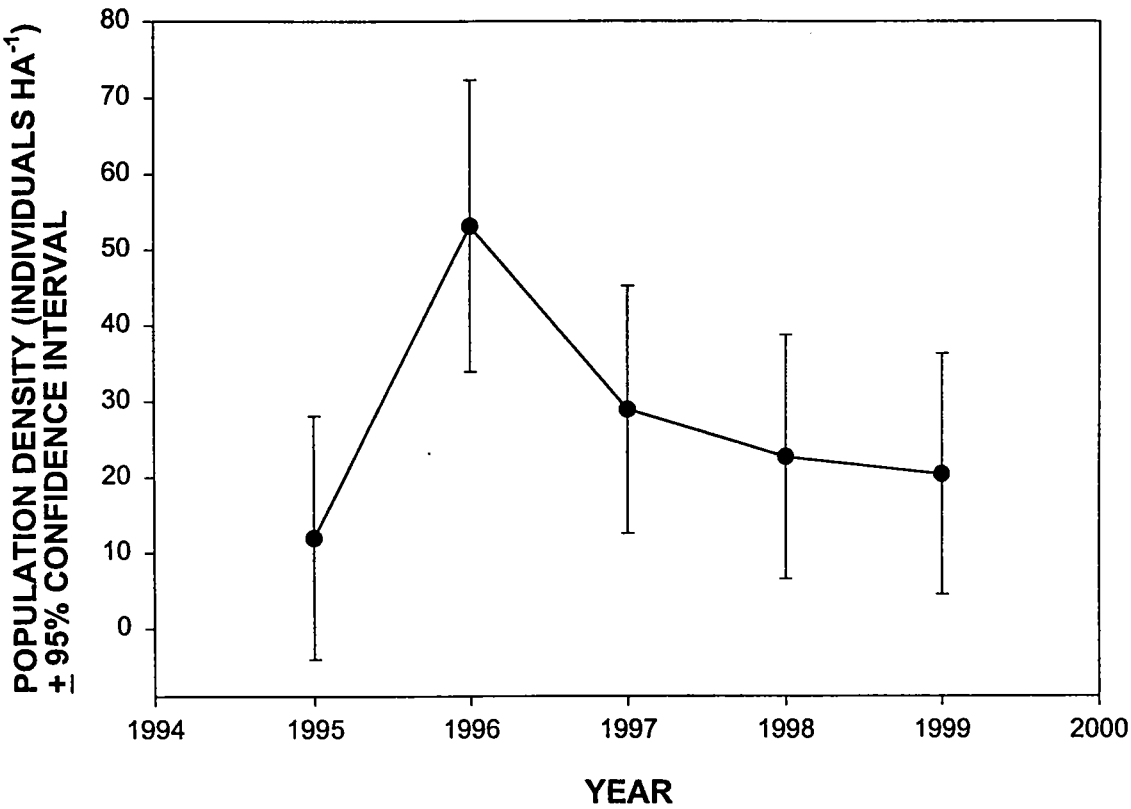


Figure 2. Estimates of black-tailed prairie dog total colony populations(individuals colony^{-1}), $\pm$ 95% confidence intervals from 1995 through 1998 at Scotts Bluff National Monument.

SCOTTS BLUFF NATIONAL MONUMENT

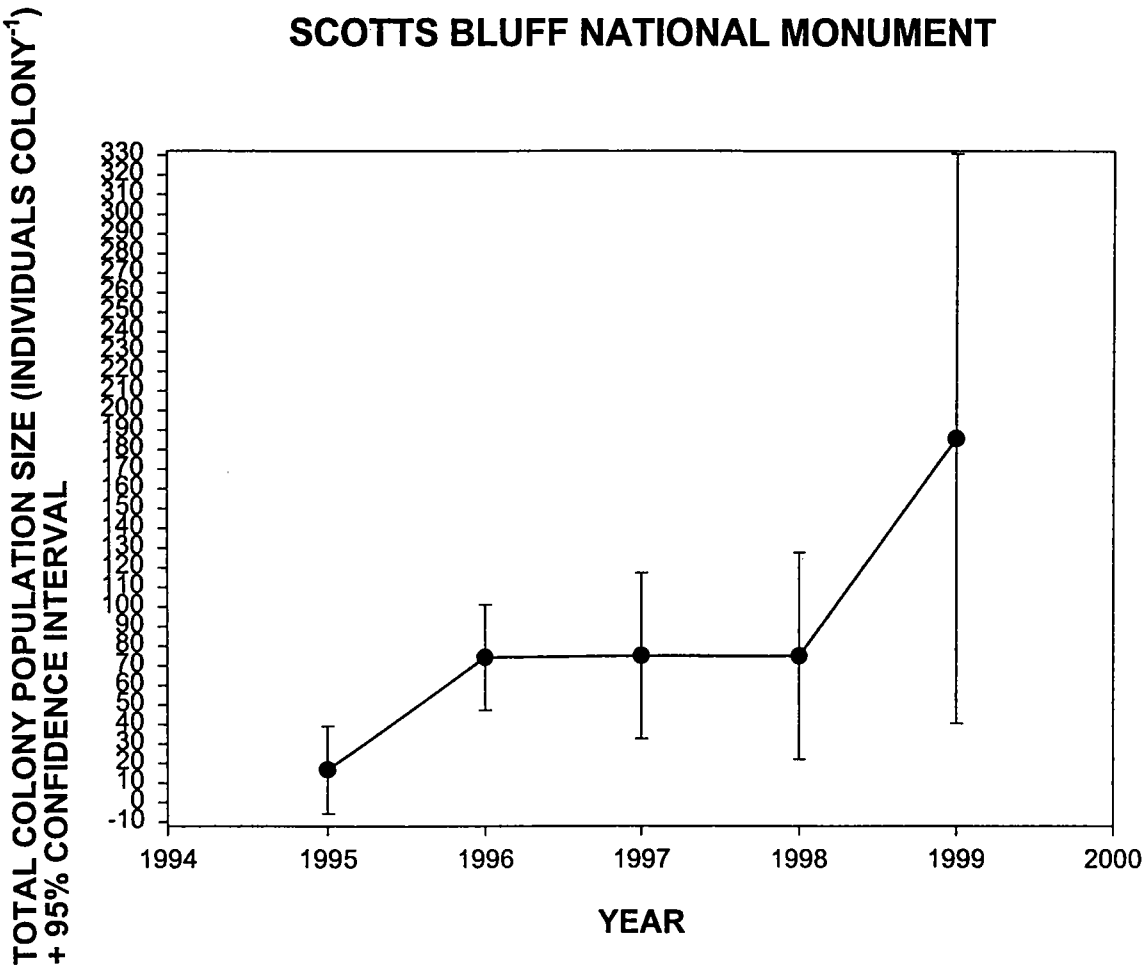


Figure 3. Map of the black-tailed prairie dog colony at Scotts Bluff National Monument in 1995.

Figure 4. Map of the black-tailed prairie dog colony at Scotts Bluff National Monument in 1997.

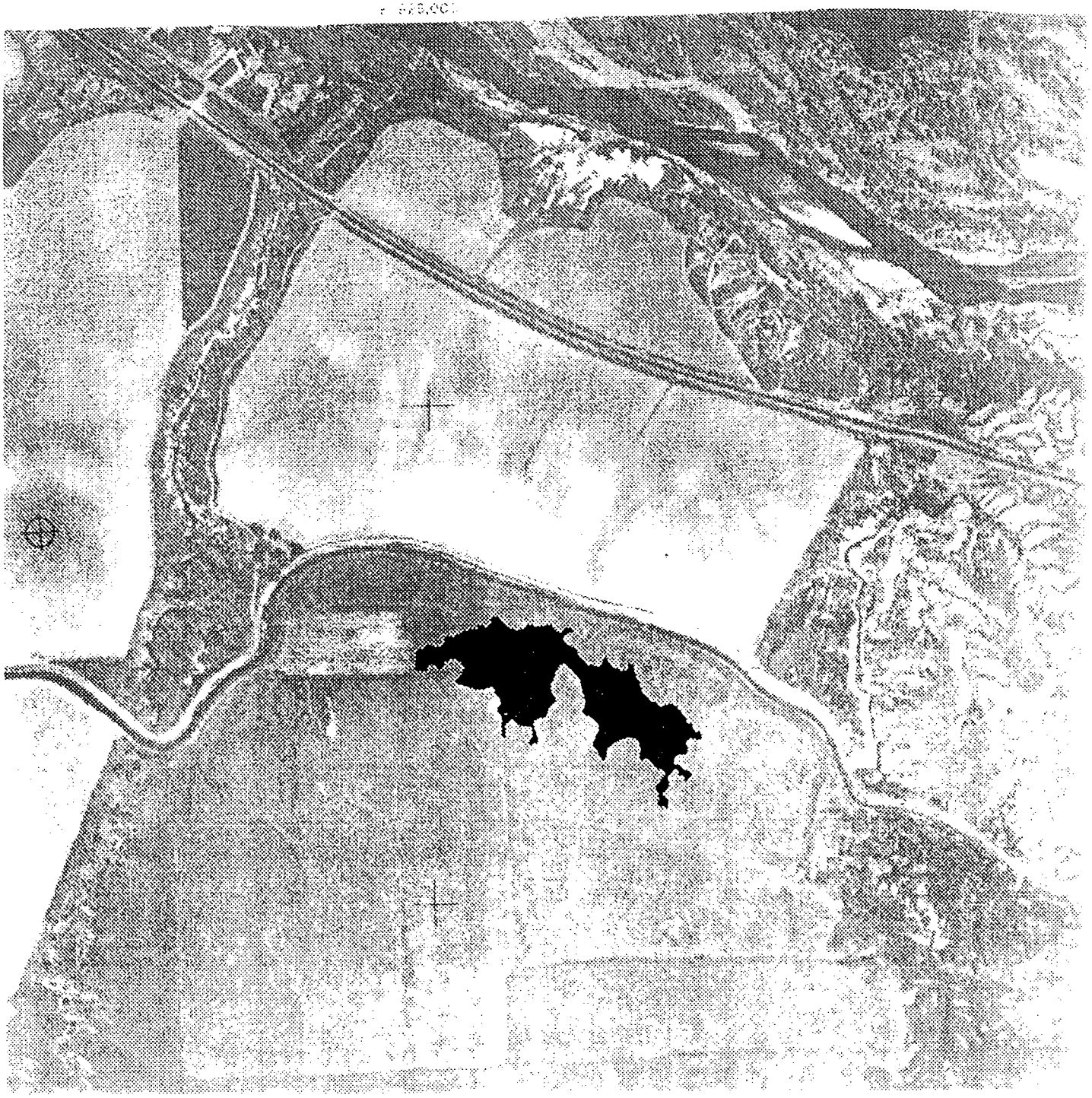


Figure 5. Map of the black-tailed prairie dog colony at Scotts Bluff National Monument in 1998.

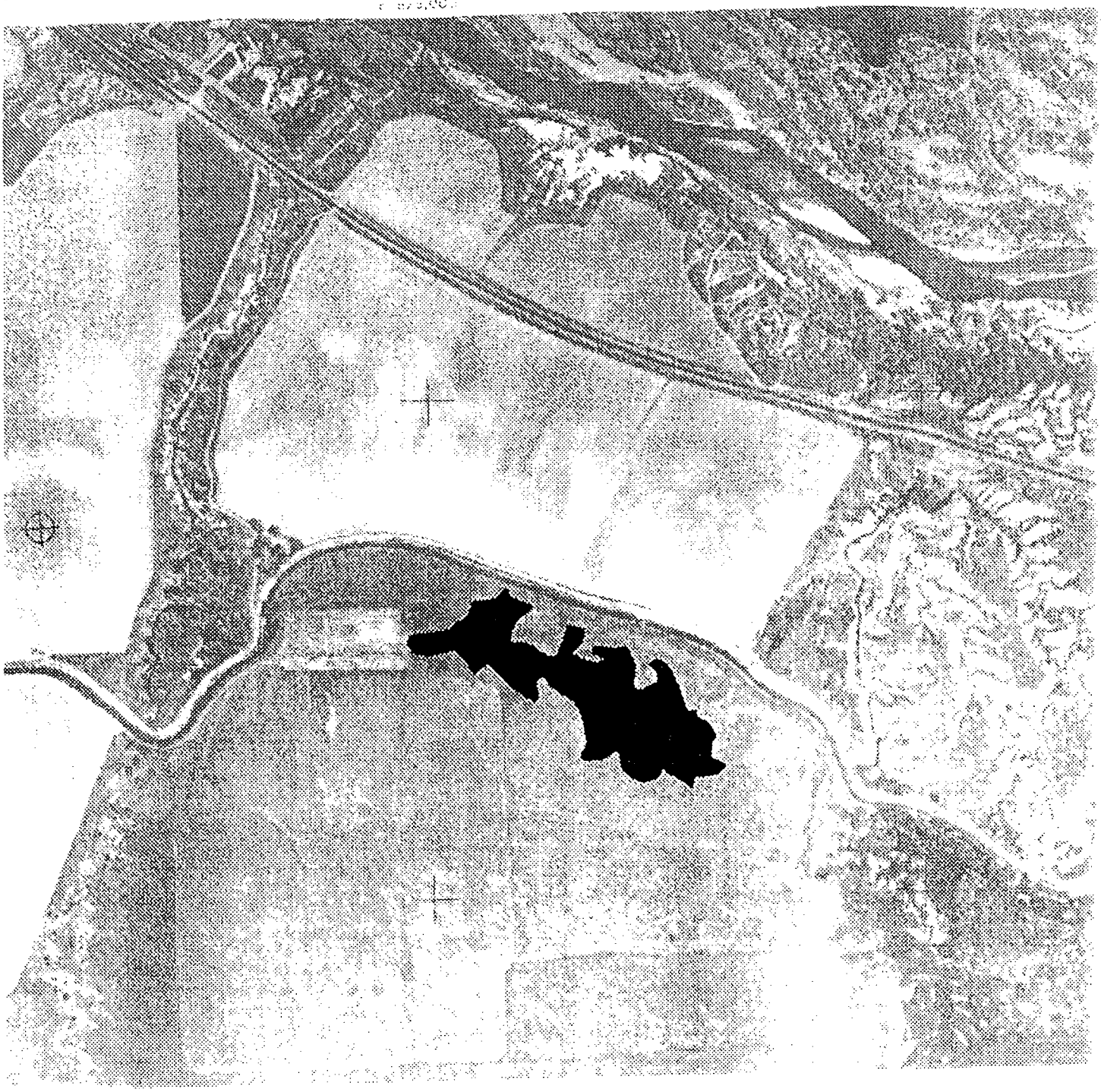
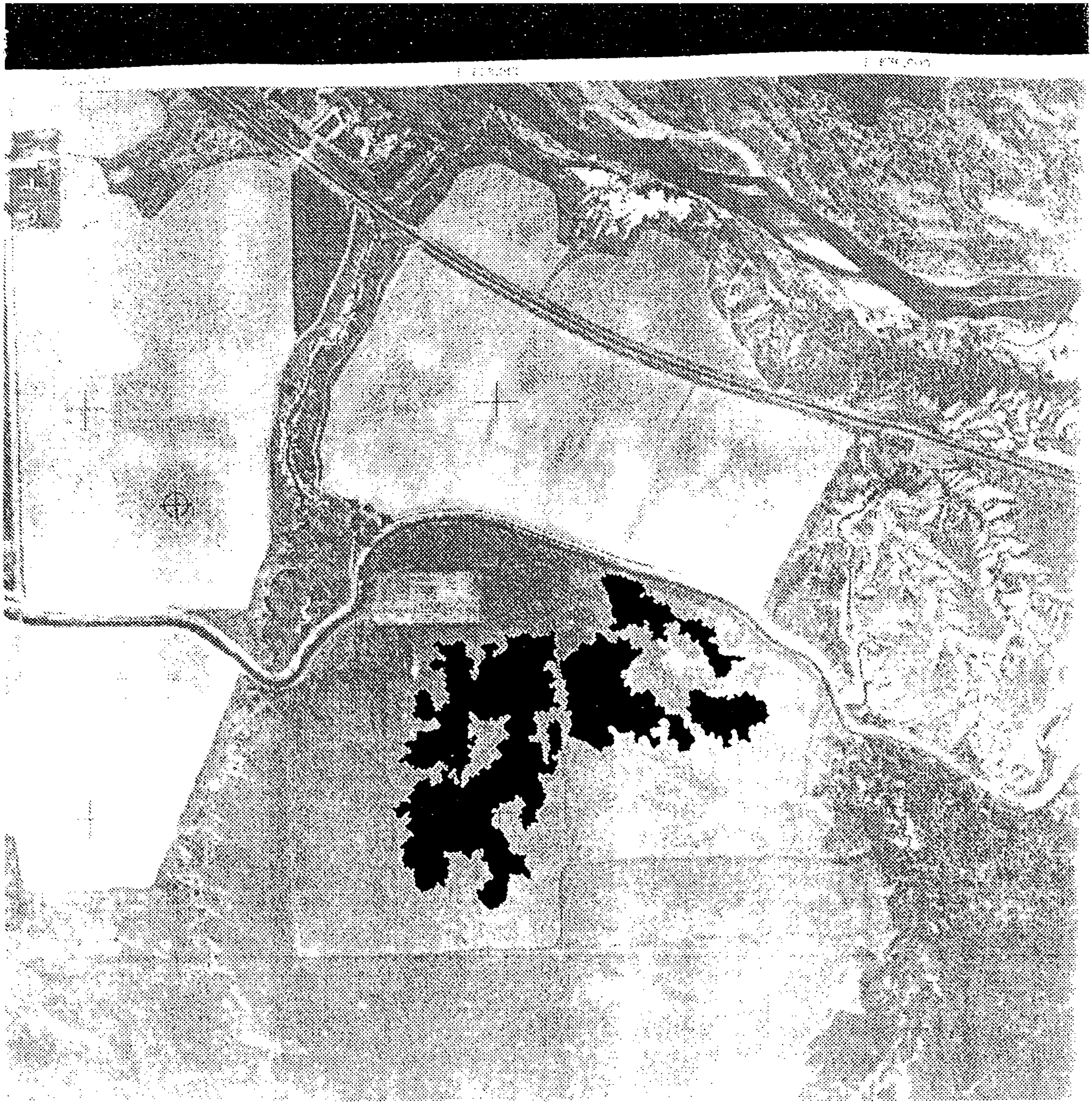


Figure 6. Map of the black-tailed prairie dog colony at Scotts Bluff National Monument in 1999.



Appendix A. Below are listed the respective contacts (as of March 1998) who should be alerted upon detection or strong suspicion of a plague epizootic within or adjacent to Scotts Bluff National Monument.

National Center for Disease Control (CDC) contact

Dr. Ken Gage
Centers for Disease Control and Prevention CDC/DVBID
Foothills Campus, P.O. Box 2087
Fort Collins, CO 80522
(303) 221-6450; klg0@cdc.gov

Wildlife Disease Diagnostic Laboratory contact

Dr. Beth Williams
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Nebraska (Scotts Bluff National Monument)

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